Mn-DPDP   :

[1]

[1, 2].

:   (Mn-DPDP)   MR

.

: Mn-DPDP   MR   28   36   (> 1 cm)

.   .

Mn-DPDP   15   T1

. Mn-DPDP   MR

(,   ,   )   ,

(contrast to noise ratio,   CNR)   [signal enhancement

ratio(%)]   .   ,   CNR

.

: Mn-DPDP   MR   3 cm   74% (14/19)

3 cm   47% (8/17)

(p> 0.05). 3 cm   35% (6/17)   3

cm   (p< 0.05).

3 cm   3 cm

(p< 0.05).

(p< 0.05).   CNR

.

: Mn-DPDP   MR   3 cm   3 cm

.   CNR

.

man-   MR

gafodipir trisodium(Mn-DPDP)

(1-10).   .

(needle biopsy)

(het-

,   ,   erogeneity)   (sampling error)

(3, 4).   .

Mn-DPDP   MR   .

(2-10). Murakami   (6)   Mn-DPDP   .

Mn-

DPDP   MR   .

2000   12   2001   7
    CT (*n*= 19)   CT
(*n*= 19)   34
    Mn- DPDP   MR   .
            (percutaneous radiofrequency thermal
ablation)   5   (transarterial
chemoembolization)   .
            28   .
20   8   21- 66 (47)
 . 28   12   7   , 6
              ,   3   .

                    CT
          .

                              .

  MR   1   26   6.2
    .   10%
            (embed)   5 mm   .
                4 μm   hematoxylin-
eosin   .
MR   .   17
                    11
    .
              0.3- 12.5 cm(, 3.0 cm)   48
                    1 cm
36   .   1 cm
    (parial volume artifact)
              1 cm   36
          .

              ,   ,
        (11). 36   24
              12   2
            .   2
                  7

                              .

                              .
36
6 ,   26   4   .

  Mn- DPDP   *MRI*
    MR   1.5T   (Horizon;
General Electric Medical Systems, Milwaukee, WI, U.S.A.)

        :   Mn- DPDP

            (phased array multi- coil)
    .
    Mn- DPDP   (Mangafodipir trisodium, Teslascan ,
Nycomed, Amersham, Oslo, Norway)   5 μmol/kg (0.5
mL/kg)   2- 3 mL/min   10
                  .
    Mn- DPDP   15
          T 1   (TR/TE range,
200/4.2; flip angle, 90°)   .
    6- 7 mm,   2 mm,   256× 128- 160,
FOV   30- 36 cm   .

    Mn- DPDP   MR
                  .
                        (hypointense),
    (isointense),   (hyperintense)   .

        . Fisher's exact test
              P   0.05
      .

    2K× 2K PACS (PACS, PathSpeed Workstation; General
Electric Medical Systems, Milwaukee, WI, U.S.A.)
                                      Mn-
DPDP   T 1   (region of
interest,   ROI)   ,
                  .
                          ,   ,
                  .
ROI
                              .
                    (phase encoding direc-
tion)   ROI   .
    ROI   256 mm²(, 256- 1,560 mm²),
    ROI   50 mm²(, 50- 4,012 mm²),
    ROI   256 mm²(, 256- 712 mm²)
    . ROI   .
                    (parameter)
        (signal to noise ratio,   SNR),
                (contrast to noise ratio,
CNR),   [signal enhancement ratio (%),
    ER]   .
        SNR   ROI
                              ROI
                          .
                CNR   :

[(-   )/

]. Mn- DPDP

CNR

Mann-
Whitney test   P

, CNR   0.05

, CNR

-                                      CNR

[signal enhancement ratio(%)]

:   (%): [(SNR-

SNR)/   SNR]× 100.

Table 1. Enhancement Pattern of Hepatocellular Carcinoma Relative to Surrounding Liver Parenchyma on Mangafodipir Trisodium (Mn-DPDP)-Enhanced MR Images According to the Lesion Size

| Size (cm)	Hyperintense	Isointense	Hypointense
1- 3 cm ($n=19$)	14 (74%)	5 (26%)	0
> 3 cm ($n=17$)	8 (47%)	3 (18%)	6 (35%)
p-value	0.17	0.69	0.02
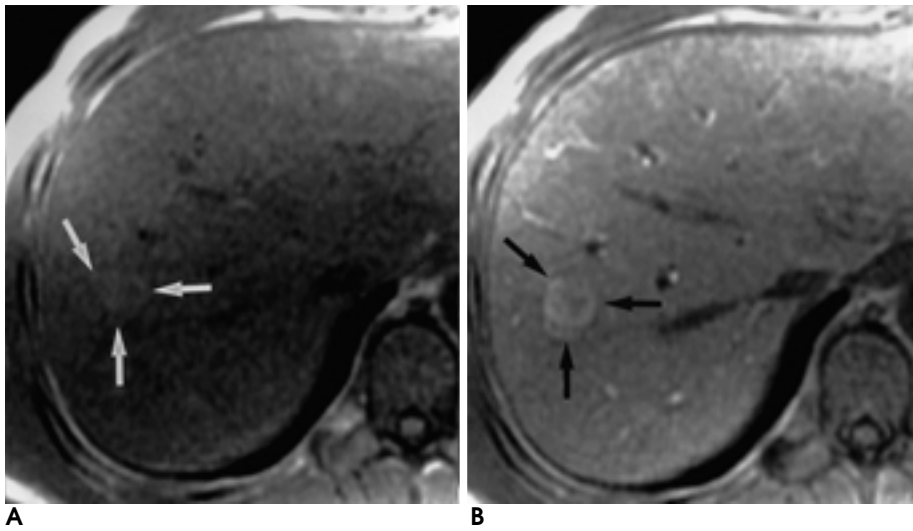
Fig. 1. 45-year-old man with 2.1 cm sized a moderately differentiated hepatocellular carcinoma in segment VIII of liver.
A. Precontrast in-phase T1-weighted fast multiplanar spoiled gradient-recalled echo image (TR/TE, 200/4.2; flip angle, 90°) shows lesion (arrows) as isodense or slightly hyperintense to surrounding liver parenchyma.
B. On postcontrast T1-weighted fast multiplanar spoiled gradient-recalled echo image, this lesion (arrows) shows hyperintense enhancement to surrounding liver parenchyma except a small central portion.
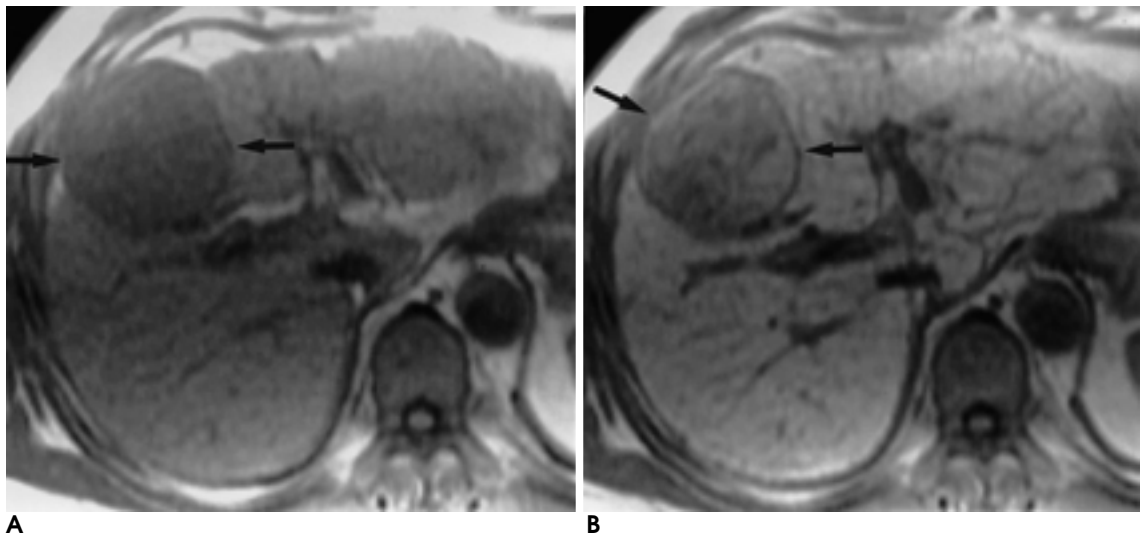
Fig. 2. 56-year-old man with 5.2 cm sized a moderately differentiated hepatocellular carcinoma in segment IV of liver.
A. Precontrast in-phase T1-weighted fast multiplanar spoiled gradient-recalled echo image (TR/TE, 200/4.2; flip angle, 90°) shows lesion (arrows) as hypointense to surrounding liver parenchyma.
B. On postcontrast T1-weighted fast multiplanar spoiled gradient-recalled echo image, this lesion (arrows) shows inhomogeneous hypointense enhancement to surrounding liver parenchyma.

: Mn-DPDP

(Fig. 3).

, (p> 0.05).

Mn-DPDP MR
Table 1
. Mn-DPDP MR 3 cm
74% (14/19) (Fig. 1) 3 cm
47% (8/17)
(p> 0.05). 3 cm
35% (6/17) (Fig. 2) 3 cm
(p< 0.05).
Mn-DPDP MR
Table 2
. 83% (5/6),
62% (16/26)
25% (1/4) .
23% (6/26) 4
50% (2/4)

, (p> 0.05).

Mn-DPDP MR
CNR Table 3
3 cm 3 cm
(p< 0.05).
CNR
Mn-DPDP MR
CNR Table
4 .

(Fig.
4, 5) (Fig. 3)
(p< 0.05).

Table 2. Enhancement Pattern of Hepatocellular Carcinoma Relative to Surrounding Liver Parenchyma on Mn-DPDP-Enhanced MR Images According to the Histopathologic Grade

Histologic grade	Hyperintense	Isointense	Hypointense
Well differentiated (grade I) (n=6)	5 (83%)	1 (17%)	0
Moderately differentiated (grade II) (n=26)	16 (62%)	4 (15%)	6 (23%)
Poorly differentiated (grade III) (n=4)	1 (25%)	1 (25%)	2 (50%)
p-value grade I vs II, III	0.37	1	0.30
grade I, II vs III	0.28	0.53	0.21

A   B
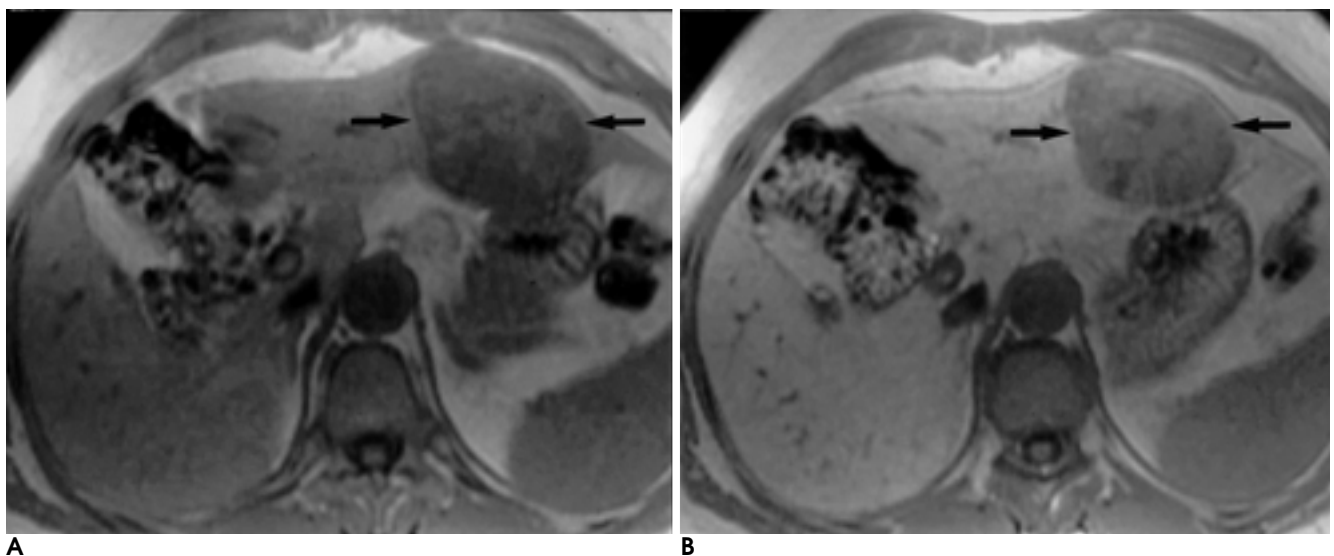
Fig. 3. 55-year-old woman with 6.7 cm sized a poorly differentiated hepatocellular carcinoma in left lateral segment of liver.
A. Precontrast in-phase T1-weighted fast multiplanar spoiled gradient-recalled echo image (TR/TE, 200/4.2; flip angle, 90°) shows lesion (arrows) as inhomogeneous hypointense to surrounding liver parenchyma.
B. On postcontrast T1-weighted fast multiplanar spoiled gradient-recalled echo images, this lesion (arrows) shows inhomogeneous hypointense enhancement to surrounding liver parenchyma.

CNR   .

                    CNR
(*p*> 0.05).

Manganese (II) N,N'- dipyridoxylethylenediamine- N,N'-
diacetate 5,5"- bis (phosphate) (Mn- DPDP)
                              T1   T1

        (12).
Mn- DPDP   MR   ,   ,
                                                (3, 4).
                                                            ,

        CNR   (4).

    MR   .

                (13).

2 cm   50%

                                        .   Mn- DPDP
MR   3 cm   19
        6 ,   13   14
            , 3 cm   17
        13 ,   4   8
    , 3   , 6   .   3 cm
                              74% (14/19)   3
cm   47% (8/17)
                              (*p*> 0.05). 3 cm
        35% (6/17)   3 cm

Table 3. Lesion to Liver CNR and Signal Enhancement Ratio of
Hepatocellular Carcinoma on Mn-DPDP-Enhanced MR Images
According to the Lesion Size

Size (cm)	Lesion to liver CNR	Signal ER of lesion (%)
1- 3 cm (*n*=19)	4.7± 5.7	56.2± 18.8
> 3 cm (*n*=17)	4.7± 3.8	40.8± 22.7
p-value	0.43	0.03

Data are mean± 1 standard deviation
CNR = contrast to noise ratio, ER = enhancement ratio

Table 4. Lesion to Liver CNR and Signal Enhancement Ratio of Hepatocellular Carcinoma on Mn-DPDP-Enhanced
MR Images According to the Histopathologic Grade

Histologic grade	Lesion to liver CNR	Signal ER of lesion (%)
Well differentiated (grade I) (*n*=6)	3.3± 2.3	53.8± 21.1
Moderately differentiated (grade II) (*n*=26)	5.3± 5.5	50.3± 22.0
Poorly differentiated (grade III) (*n*=4)	3.2± 2.6	20.6± 16.2
p-value grade I vs II, III	0.39	0.61
grade I, II vs III	0.68	0.02

Data are mean± 1 standard deviation
CNR = contrast to noise ratio, ER = enhancement ratio

A

B
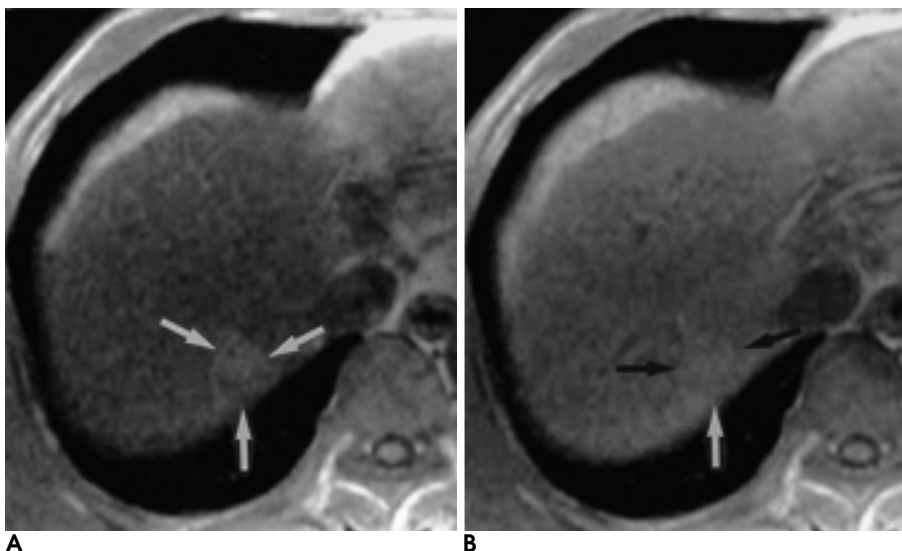
Fig. 4. 60-year-old man with 2.2 cm
sized a well-differentiated hepatocellu-
lar carcinoma in segment VIII of liver.
A. Precontrast in-phase T1-weighted
fast multiplanar spoiled gradient-re-
called echo image (TR/TE, 200/4.2; flip
angle, 90°) shows lesion (arrows) as hy-
perintense to surrounding liver
parenchyma.
B. On postcontrast T1-weighted fast
multiplanar spoiled gradient-recalled
echo image, this lesion (arrows) shows
homogeneous isointense enhancement
to surrounding liver parenchyma.

A　　　　　　　　　　　　　　　　　**B**
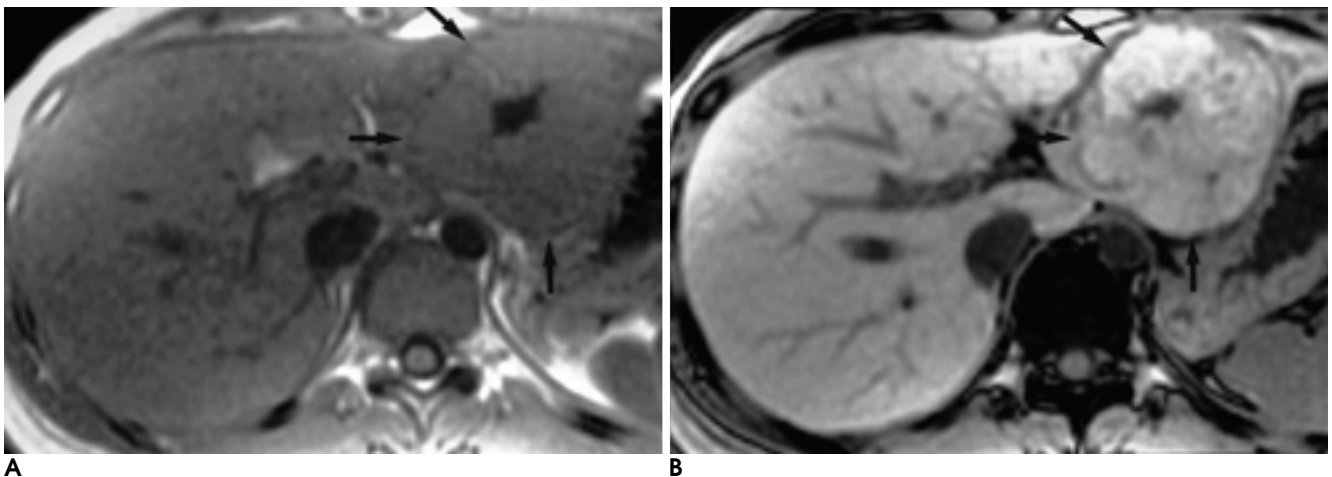
Fig. 5. 21-year-old woman with 7.2 cm sized a moderately differentiated hepatocellular carcinoma in left lateral segment of liver.
A. Precontrast in-phase T1-weighted fast multiplanar spoiled gradient-recalled echo image (TR/TE, 200/4.2; flip angle, 90°) shows lesion (arrows) as isointense to surrounding liver parenchyma with central hypointense area.
B. On postcontrast T1-weighted fast multiplanar spoiled gradient-recalled echo image, this lesion (arrows) shows homogeneous isointense enhancement to surrounding liver parenchyma except central hypointense area.

($p< 0.05$).　　　　　　　3 cm
　　3 cm　　　　　　　　　　　　　　　.　　　　　　.
　　3 cm　　　　　　3 cm　　　　　　　　　　　　　　　　.
　　　　　　　　　　　　Mn- DPDP　　　　　　　　　　　　.
　　　　　　　　　　　　　　12 (33%)
　　　　　　　(10).　　　　　　　　　　　SNR
Mn- DPDP　　MR　　　　　　　.　　　　　　　　　　　　ROI
(6, 9, 10).　　　　　　　　　　　　　　　.
　　　　　　　　　　　　,
　　　　　　　　　.　　　　　　.
　　　　　　　　　　　　　　1 cm

　　　　　　(10).　　　　　　.

　(6). Murakami　(6)　T1　　　　　　　　　　　　　　.
　　　　　　　CNR　　　　　　　24　　　　　　.
　　　　　　　　　24　　　　　　　38% (49/129)
　　　　　.　　　　　　83%　　　　(8)
(5/6)　　　62% (16/26)　　　　　　　　(4, 9).
　　　50% (2/4)　　　24
.　　　　　　　　　　.
　　　　　　Mn- DPDP　　MR　　3 cm
　　Murakami　(6)　　3 cm
.　　　　　.
　　　　　　　　　.
　　CNR
.

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Mangafodipir Trisodium (Mn-DPDP)-Enhanced MR Imaging of Hepatocellular Carcinoma: Correlation with Histopathological Findings[1]

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Purpose: To correlate the contrast enhancement pattern of hepatocellular carcinoma (HCC) seen at mangafodipir trisodium (Mn-DPDP)-enhanced MR imaging with the histopathologic findings.

Materials and Methods: In 28 patients with 36 HCCs larger than 1 cm, Mn-DPDP-enhanced T1-weighted fast multiplanar spoiled gradient-recalled echo (GRE) MR images were obtained before and 15 mins after Mn-DPDP administration. Qualitative analysis focused on signal intensity (hyper-, iso-, or hypo-) relative to surrounding liver parenchyma, while the signal enhancement ratio [ER (%)] and lesion-to-liver contrast-noise ratio (CNR) were determined quantitatively. Signal intensity relative to surrounding liver parenchyma, lesion-to-liver CNR and signal ER of the lesions were correlated with their size and histopathologic grade.

Results: The imaging procedure showed that relative to surrounding liver parenchyma, 74% (14/19) of HCCs 1- 3 cm in size but 47% (8/17) of those larger than 3 cm were hyperintense. There was, however, no significant difference between the two groups ($p > 0.05$). In addition, 35% (6/17) of HCCs larger than 3 cm but none of the 19 smaller lesions were hypointense, with a significant difference between the two groups ($p < 0.05$). Signal ER of the 1- 3 cm lesions was significantly higher than in the larger lesions ($p < 0.05$), and in well and moderately differentiated HCCs was significantly greater than that in those that were poorly differentiated ($p < 0.05$). Differences in lesion-to-liver CNR the two groups were not statistically significant ($p > 0.05$).

Conclusion: At Mn-DPDP-enhanced MR imaging, HCCs 1- 3 cm in size showed greater signal intensity and signal ER than HCCs larger than 3 cm. Well or moderately differentiated HCCs showed greater signal ER than those that were poorly differentiated. Lesion-to-liver CNR did not differ according to lesion size and histopathologic grade.

Index words : Liver, MR
Liver, neoplasms
Manganese
Magnetic resonance (MR), contrast enhancement

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